

SESSION 4: SMART FEED MANAGEMENT



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Smart Feed Management and Use of IoT in Aquaculture

Abstract

Shrimp farming is one of the economically important practices in aquaculture and contributes significantly to the GDP growth in India. High cost of production is the major challenge in traditional shrimp farming. To overcome such challenges, there is a need to adopt new technological advances such as 'Internet of Things' (IoT). Recently, there has been substantial advancement in innovation and use of information technology tools in aquaculture that include sensor-based feeding devices, automatic water quality assessment made possible through pre-installed probes and mobile apps that capture real-time data and alert farmers. All these tools significantly help farmers in data-driven decision making. Growel has conducted a study on the efficacy of manual feeding versus timer-based auto-feeding versus sensor-based (acoustic) auto-feeding. Results showed that acoustic auto-feeding of extruded feeds generated higher production efficiency (biomass 9,200 kg), higher harvest weight (31.25g), good feed conversion ratio (1.13) and good survival rate (92%) compared to the feeding of extruded or pelleted feeds through the other two feeding systems. The stocking density, days of culture and water quality parameters were kept constant across all treatments while carrying out the above study. It was concluded that extruded feeds in combination with sensor-based auto-feeders results in higher yields.

The Growel Aqua 360° Mobile App is a complete aquaculture management platform for shrimp and fish farmers. It helps farmers to manage their farms and ponds effectively by helping them to easily log and keep track of culture metrics and parameters. The farmers are registered through a web portal by mapping their farms. The metrics and parameters that can be tracked using the app are tailored by leading aquaculture experts and incorporate the latest advances in aquaculture research and help farmers to adopt industry's best practices seamlessly. It includes a chat facility for farmers to connect to technical experts to get the right advice at the right time and maximise their productivity. It keeps farmers up to date with the latest news and articles from the aquaculture industry around the world. It includes several convenient calculators that are essential for day-to-day proactive farm management.



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AQUACULTURE
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A shared vision for aquaculture in Asia
6 - 7 October 2022 • Ho Chi Minh City • Vietnam



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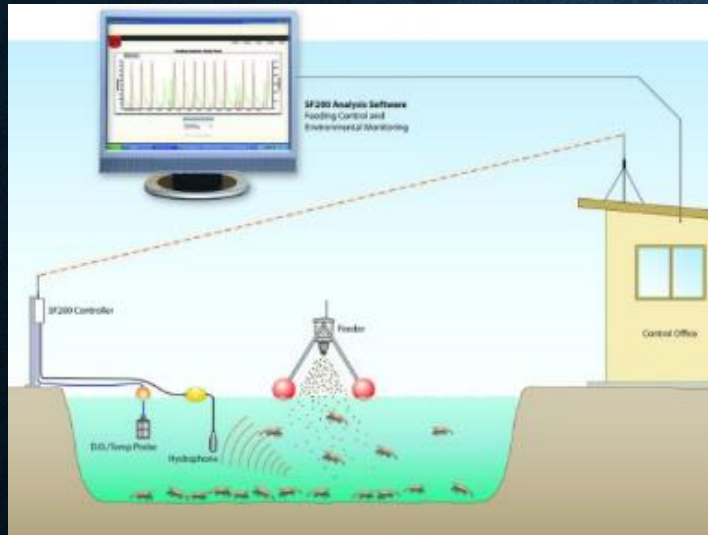
Trends in Farming Shrimp



Nursery rearing gaining importance



More focus on pond preparation, feeding and water quality management



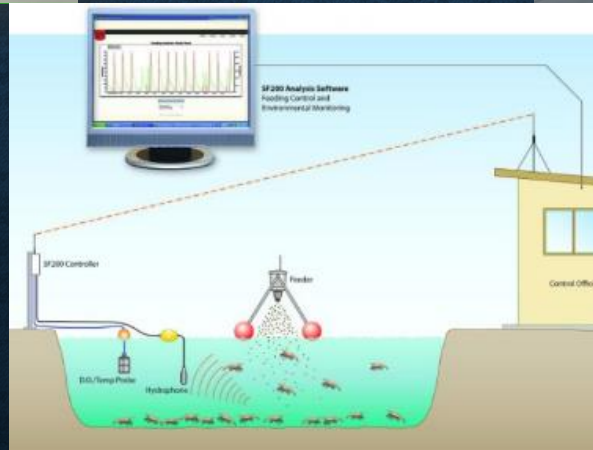
Use of IoT in farming especially for feeding and water quality management



Increase in the use of functional feeds

IoT for Shrimp Farming

Shrimp farming still lacks the technology adoption and resource efficiency.
IoT devices and mobile-based decision tools for real-time monitoring and automation of aquaculture farms to reduce the risk and improve profitability of farms.



Feed Management – Prevailing Feeding Rate in INDIA

Feed Type		No. of pellets/kg	Mean Weight of pellet (g)
Pre-grower	(1.6 mm)	150,000	0.007
Grower - 1	(1.8 mm)	120,000	0.008
Grower - 2	(2.0 mm)	90,000	0.01



Pellets Offered to Shrimp as per the Prevailing Feeding Rate

ABW (g)	Feed	Pellets/shrimp/meal
4-10	Pre-grower	12
10-13	Grower 1	11
13-17	Grower 1	13
17-20	Grower 2	11
20-25	Grower 2	14
25-33	Grower 2	15

Shrimp of about **4g** size consumes on an average **six pellets** a meal
(4.2% of body weight/day)

Too many pellets or just the right Qty?

Ideal Feed Management – Manual Intervention

Ideal Feed Management



Feed Table



Check Tray



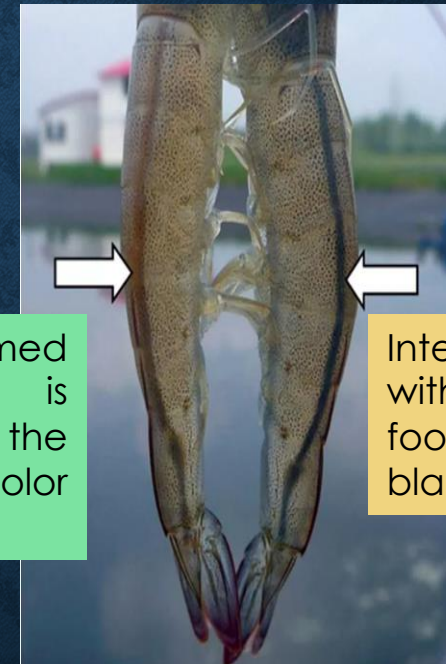
Intestine Color Check

Observing the gut

Suspected Problem	Sample	Confirmation	Action
Over feeding	1 hour before feeding	> 10% of shrimp having feed in the gut	Reduce feeding
Under feeding	1 hour after feeding	> 40% of shrimp having natural food in the gut	Increase feeding

Feed consumed by shrimp is evident by the light brown color in the intestine

Intestine filled with natural food appears blackish



Source: Ching, 2011

Manual Feeding vs Automatic Feeding

- Increasing feeding frequency improves feed efficiency
- Manual feeding by labour requires close supervision
- Two main types of automatic feeders:
 - Ration is set by the farmer and delivered using a timer
 - Acoustic Feeder: Ration is driven by the shrimp's feeding activity which is transmitted to the feeder as signals of sound



Feeding is part of Biosecurity

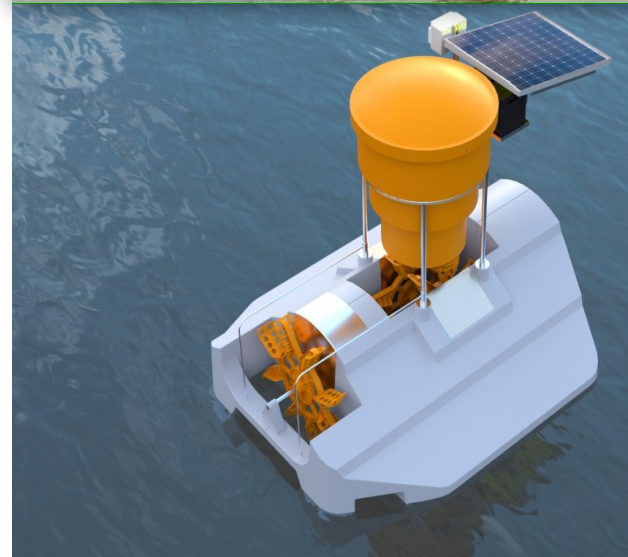
Must not overfeed or underfeed

Automation in Farming

- Farmers in future have to depend on automation. Ex: Water quality, feeding etc.
- IoT & AI (Internet of Things & Artificial intelligence) is the way forward.

Different Types of Feeds and Feeding Methods

Pelleted vs Extruded



Pellet & Extruded Feeds in Different Feeding Methods

Parameter	Manual Pellet	Manual Extruded	AF Timer Pellet	AF Timer Extruded	Acoustic Pellet	Acoustic Extruded
Pond average area (ha)	0.8	0.8	0.8	0.8	0.8	0.8
Stocking density (per/sq.m)	40	40	40	40	40	40
DOC	90	90	90	90	90	90
Harvest weight (g)	24.4	25.6	27	28.5	29.4	31.25
Harvested biomass (kg)	6246	6635	7257	7843	8467	9200
Yield/ ha	7808	5,195	9072	4,989	10584	6,327
FCR	1.31	1.26	1.25	1.19	1.15	1.13
Survival (%)	80	81	84	86	90	92
ADG (g)	0.27	0.38	0.3	0.32	0.33	0.35

Water Quality Parameters

Parameters	Standard feeding protocol (SFP)	Timer feeding	Sensor based feeding
Morning DO (mg/L)	4.11 ± 0.54	4.13 ± 0.59	4.32 ± 0.68
Afternoon DO (mg/L)	8.5 ± 1.3	8.3 ± 1.1	8.4 ± 1.5
Salinity (g/L)	12.0 ± 2.0	12.0 ± 3.0	12.0 ± 2.5
pH	8.1 ± 0.40	8.2 ± 0.40	8.2 ± 0.3
Temp (°C)	29.2 ± 2.42	29.40 ± 2.6	29.20 ± 2.8
TAN (mg/L)	0.19 ± 0.5	0.17 ± 0.5	0.10 ± 0.6

Technological Enhancement:

Data integration: Capturing Real time data with farm management software, troubleshooting and corrective measures

Feed Traceability: It includes batch feed traceability and shrimp growth performance tracking

Biosecurity and Sustainability:

High levels of Biosecurity: Restricting daily labor access to the ponds and reducing risks of contamination

Less pollution: precise feeding will reduce feed wastage and pond bottom pollution, Every 0.1 increase in FCR will produce 90 kg more organic waste/ton of shrimp production

Advantages of using feed automation systems in Shrimp farming

- **Optimization of feed consumption and labour costs**
- **optimization of feed conversion ratio**
- **Improves shrimp growth rate**
- **Less chances of size variation**

The data collected from sensors is helping shrimp farmers and Site/Farm managers to make operational decisions about the farm environment, harvest timings, health status of the shrimp and feeding levels.

ADOPTING INTERNET OF THINGS (IOT) IN AQUACULTURE

Data Collection for Proactive Management



Empowers you to make accurate decisions



Helps you to identify problems & possible reasons



Allows you to develop precise solutions



Will back up your technical services



Tells you whether you're doing well.



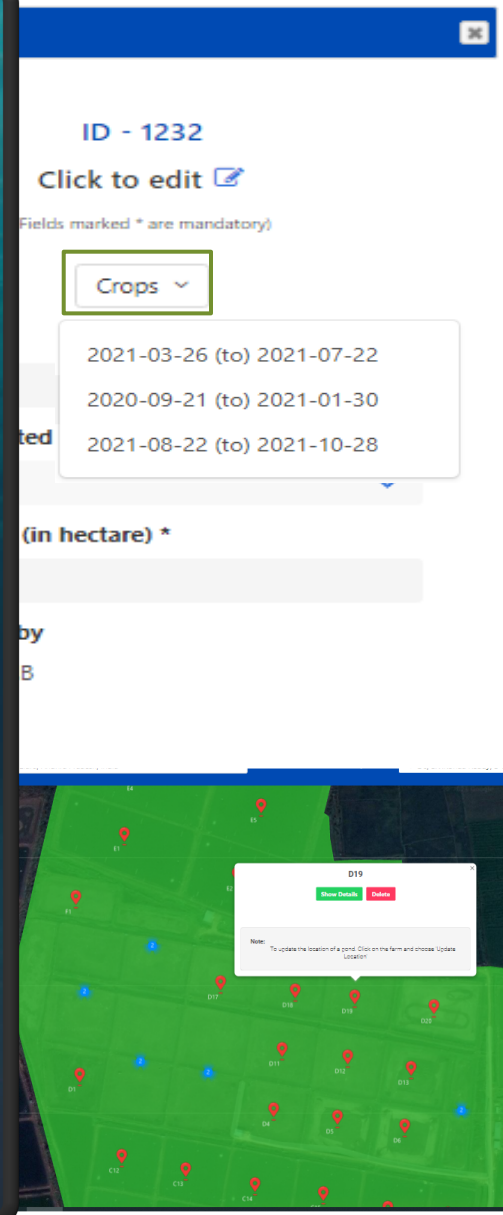
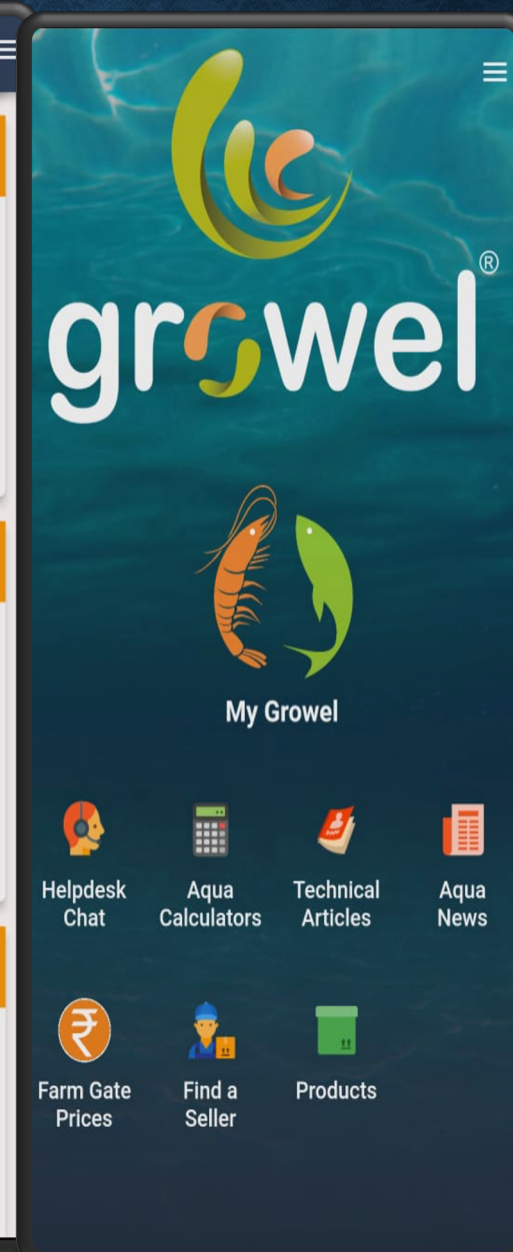
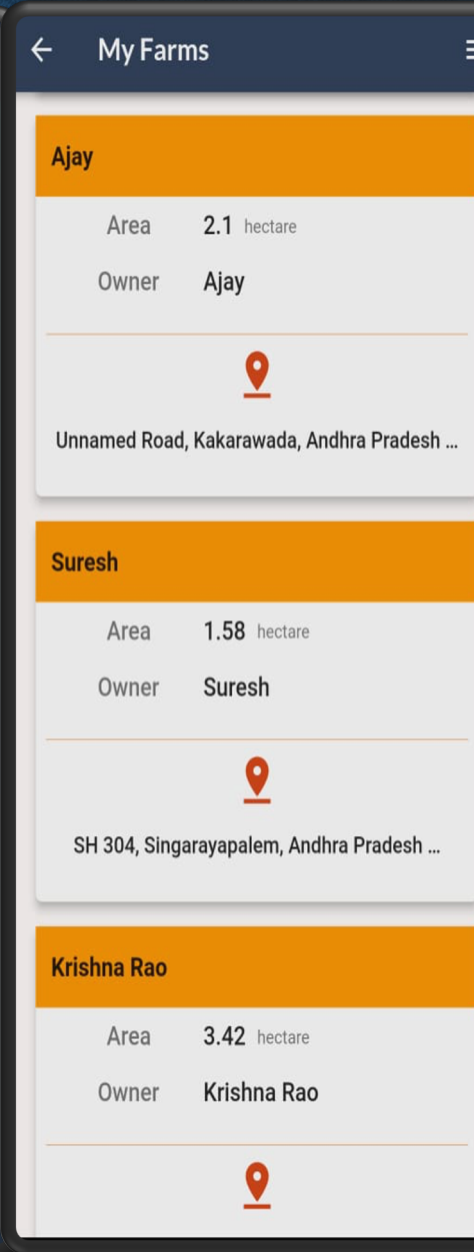
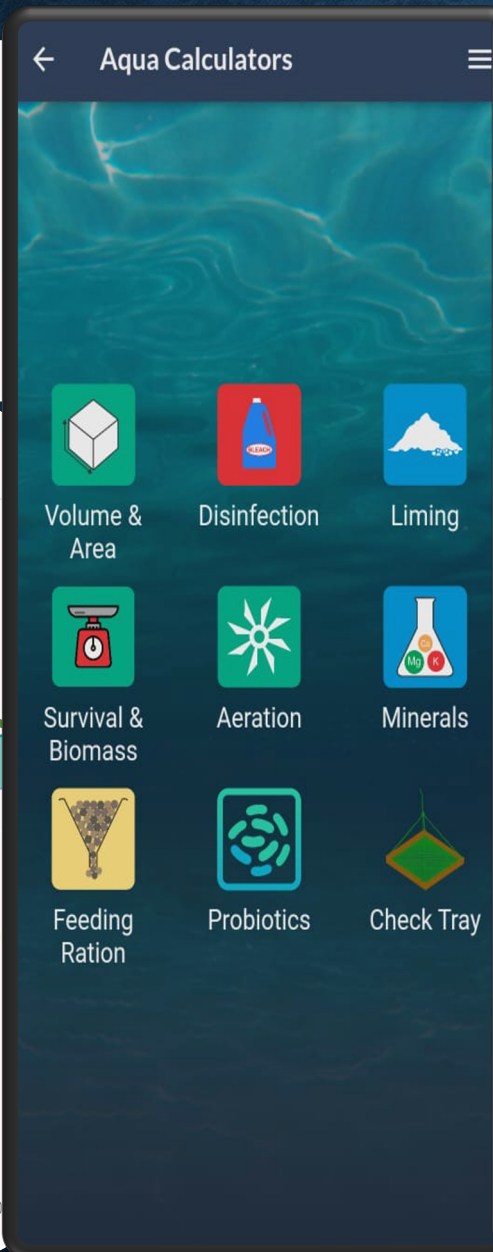
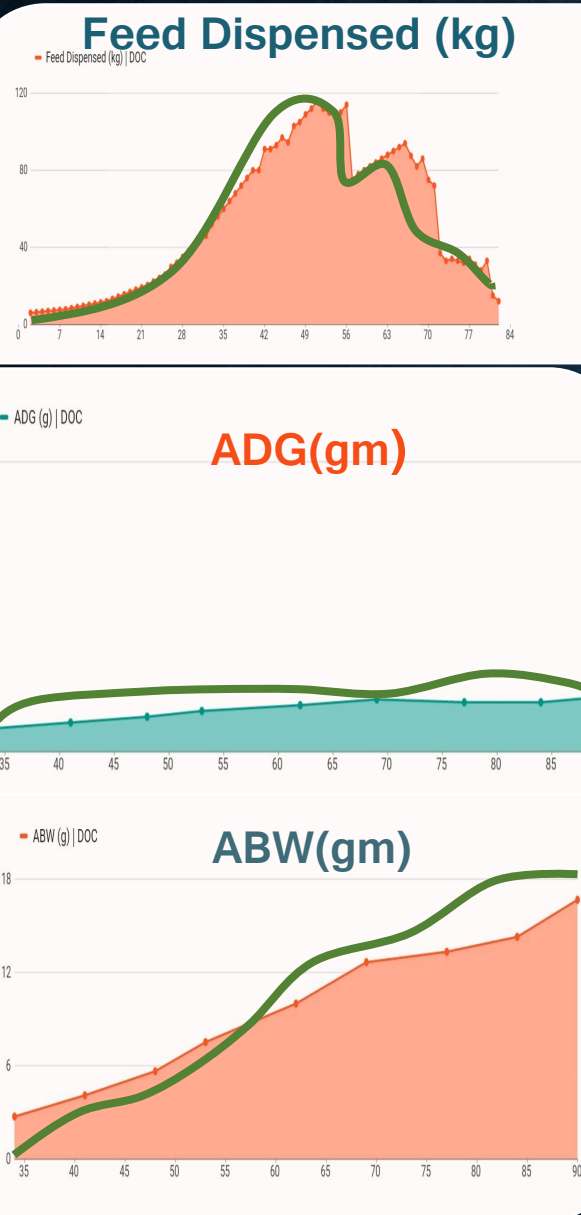
Saves your time.



Proactive management to minimize stress of shrimp.



Improves quality of decisions



- **Health & Welfare**

Ensuring the health and welfare of farms is essential, as a drop in the water quality or a disease outbreak can be catastrophic. Early detection can help farmers intervene before an outbreak occurs and improve shrimp welfare. IoT sensors can provide RT data on shrimp feed consumption, and water conditions, which can produce AI models for the early detection of less than adequate conditions.

- **Feeding Optimization**

- Feed accounts for 50 to 60% of the cost of production, Overfeeding having a negative impact on shrimp health and water quality
- The optimization of feeding can lead to significant savings and advantages.
- Many shrimp farms use sensor based feeders that rely on acoustic signals, which helps with more accurate feeding

- Internet access and speed in remote farming areas
- However, deployment of IoT technologies in remote areas like those where aquaculture is practiced is still a challenge where information needs to be sent elsewhere in the world or acquired from sensors remote to the main office.
- Dense algal blooms (microcystis) some times interrupt the Sensor function.
- Farmers in INDIA habituated for mixing of feed additives at farm level, Top coating will interrupt the feed dispensation

Take Home Message:

- The farm environment can be monitored more efficiently and with greater coverage, enabling near real-time corrective measures to be implemented (proactive management).
- The impacts of the farm on the surrounding environment can be followed more closely, allowing for better environmental management.
- IoT is a component of machine learning in that data acquired over time can be applied to create predictive models leading to more confident decision-making, timely alerts and automated systems.



Thank You



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